Introduction to Mathematical Modeling

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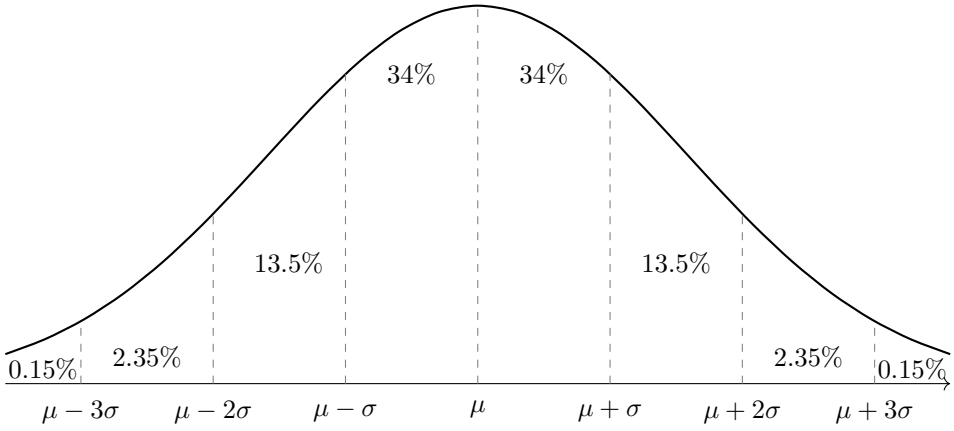
Empirical Rule (68-95-99.7 %) for Roughly Bell Shaped Curve

The **Empirical Rule**, also known as the **68-95-99.7 Rule**, describes how data is distributed in a **normal distribution** (a roughly bell-shaped curve). It states that:

- Approximately **68%** of the data falls within **1 standard deviation** of the mean, which is in between $\mu - \sigma$ and $\mu + \sigma$.
- Approximately **95%** of the data falls within **2 standard deviations** of the mean, which is in between $\mu - 2\sigma$ and $\mu + 2\sigma$.
- Approximately **99.7%** of the data falls within **3 standard deviations** of the mean, which is in between $\mu - 3\sigma$ and $\mu + 3\sigma$.

This rule applies only to distributions that are approximately bell-shaped.



Example: Applying the Empirical Rule

Let's apply the Empirical Rule to a real-world example to understand how it works step by step.
Scenario: IQ scores are approximately bell-shaped with a mean (μ) of 100 and a standard deviation (σ) of 15.

Step 1: Use the Mean and Standard Deviation

Given:

- $\mu = 100$
- $\sigma = 15$

We will now calculate the key values at 1, 2, and 3 standard deviations from the mean:

- $\mu - 3\sigma = 100 - 3(15) = 55$

- $\mu - 2\sigma = 100 - 2(15) = 70$
- $\mu - 1\sigma = 100 - 1(15) = 85$
- $\mu = 100$
- $\mu + 1\sigma = 100 + 1(15) = 115$
- $\mu + 2\sigma = 100 + 2(15) = 130$
- $\mu + 3\sigma = 100 + 3(15) = 145$

Step 2: Apply the Empirical Rule Percentages

Now we use the Empirical Rule to interpret what percent of IQ scores fall within each range:

- **Between 85 and 115** (within 1 standard deviation): $\Rightarrow$ **68%** of scores lie here.
- **Between 70 and 130** (within 2 standard deviations): $\Rightarrow$ **95%** of scores lie here.
- **Between 55 and 145** (within 3 standard deviations): $\Rightarrow$ **99.7%** of scores lie here.

End of Lecture #9